

# Soil pH

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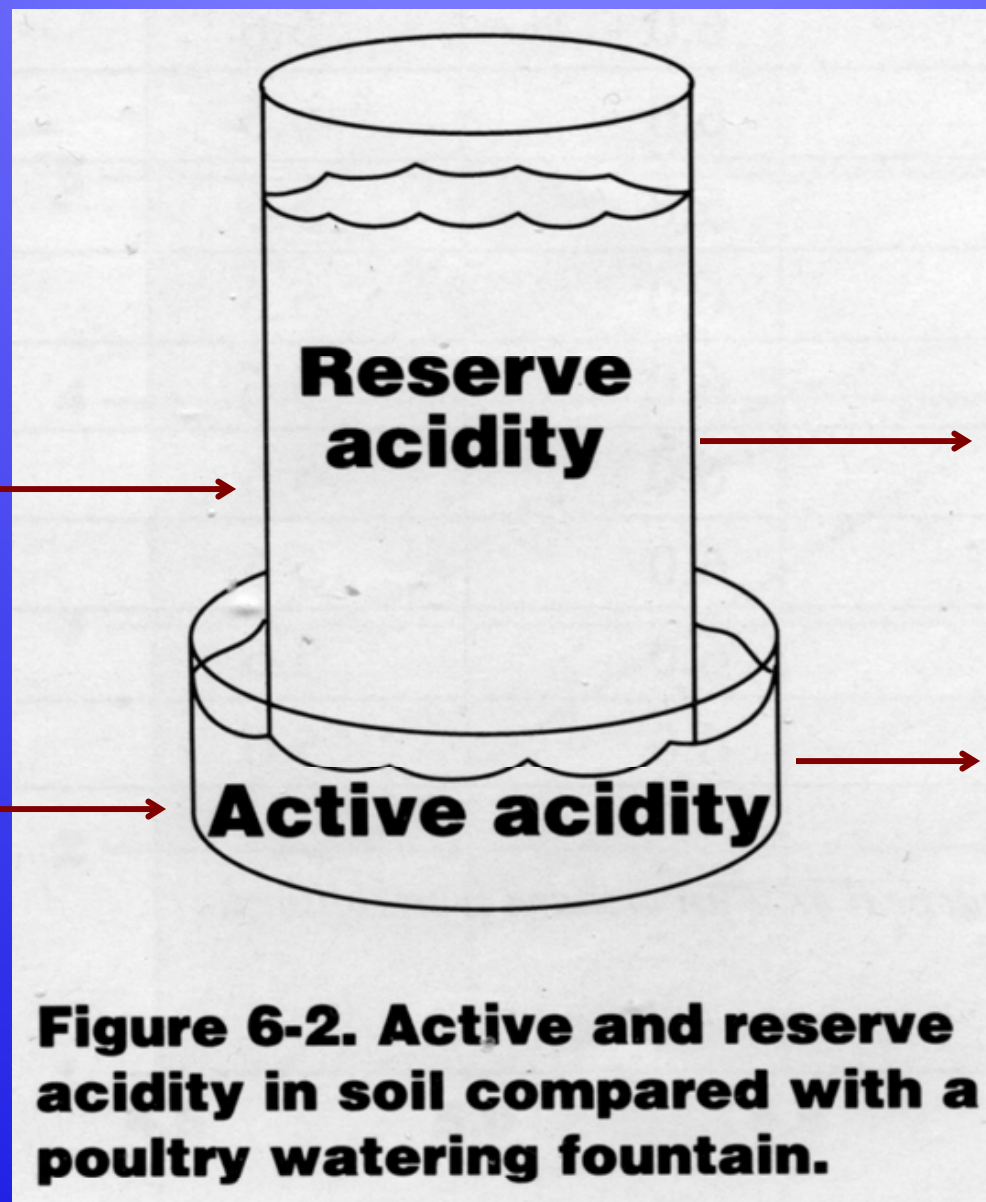
University of Minnesota

pH	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
	Very Strongly Acid	Strongly Acid	Medium Acid	Slightly Acid	NEUTRAL	Slightly Alkaline	Medium Alkaline	Moderate Alkaline	Strongly Alkaline

- $\text{pH} = -\log [\text{H}^+]$
- pH decreases as  $[\text{H}^+]$  increases: 0.0001 g  $\text{H}^+$   $\text{kg}^{-1}$  soil will have pH of 4; change  $[\text{H}^+]$  to 0.001 g  $\text{H}^+$   $\text{kg}^{-1}$  soil pH will go to 3 – ACIDIC
- pH increases as  $[\text{H}^+]$  decreases: 0.0000001 g  $\text{H}^+$   $\text{kg}^{-1}$  soil will have pH of 7; change  $[\text{H}^+]$  to 0.00000001 g  $\text{H}^+$   $\text{kg}^{-1}$  soil pH will go to 8 – ALKALINE

Buffer pH  
Sikora

Soil pH  
water



[H<sup>+</sup>] and [Al<sup>3+</sup>]  
associated with  
CEC and SOM

[H<sup>+</sup>] and [Al<sup>3+</sup>]  
in the soil solution

# H<sup>+</sup> and Al<sup>3+</sup> in the soil and OM

Clay particles

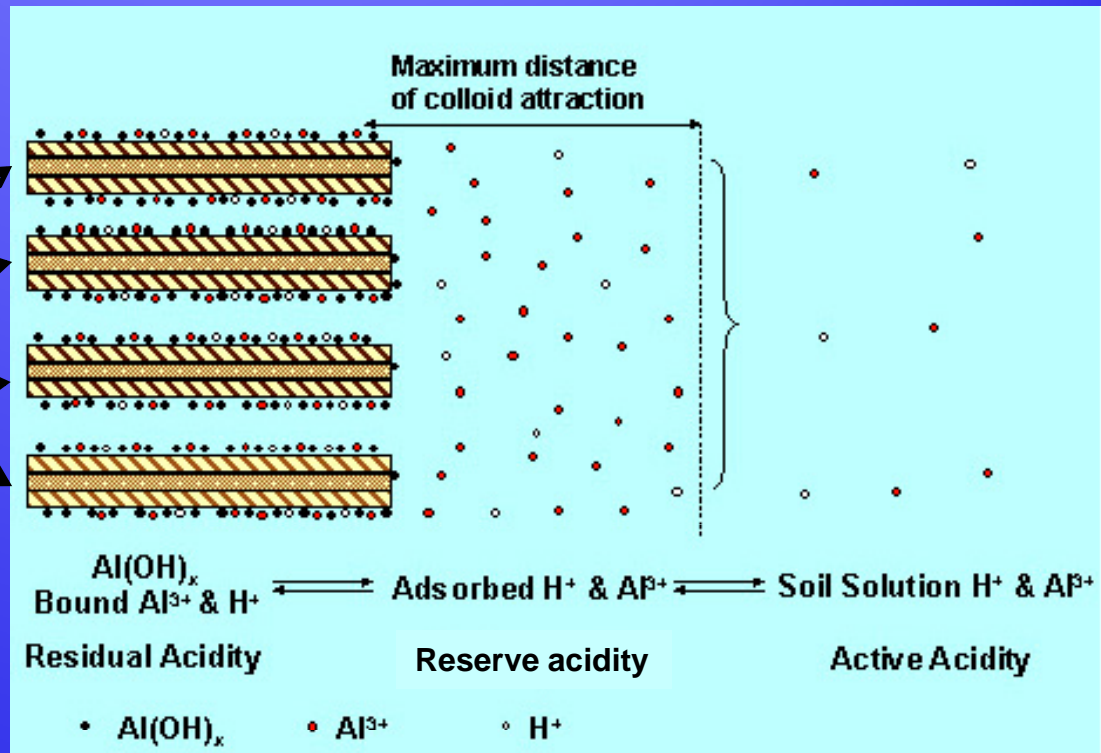
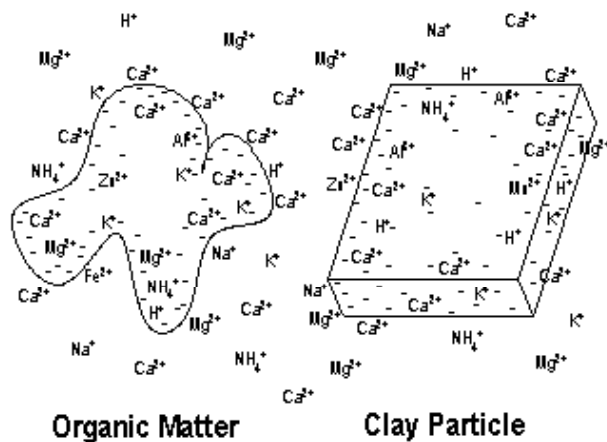


Fig. 2. Cation Exchange Capacity (CEC)



• [http://www.google.com/imgres?q=soil+cation+exchange+capacity+minerals&um=1&hl=en&sa=N&biw=1323&bih=958&tbm=isch&itbnid=8a0hUihaSm2zyM:&imgrefurl=http://hubcap.clemson.edu/~blpprt/acid1.html&docid=oOfnbaas8skS7M&imgurl=http://hubcap.clemson.edu/~blpprt/acid\\_photos/Buffering2.jpg&w=467&h=321&ei=zRqwTsqqLMGLsALT4qDjAQ&zoom=1](http://www.google.com/imgres?q=soil+cation+exchange+capacity+minerals&um=1&hl=en&sa=N&biw=1323&bih=958&tbm=isch&itbnid=8a0hUihaSm2zyM:&imgrefurl=http://hubcap.clemson.edu/~blpprt/acid1.html&docid=oOfnbaas8skS7M&imgurl=http://hubcap.clemson.edu/~blpprt/acid_photos/Buffering2.jpg&w=467&h=321&ei=zRqwTsqqLMGLsALT4qDjAQ&zoom=1)

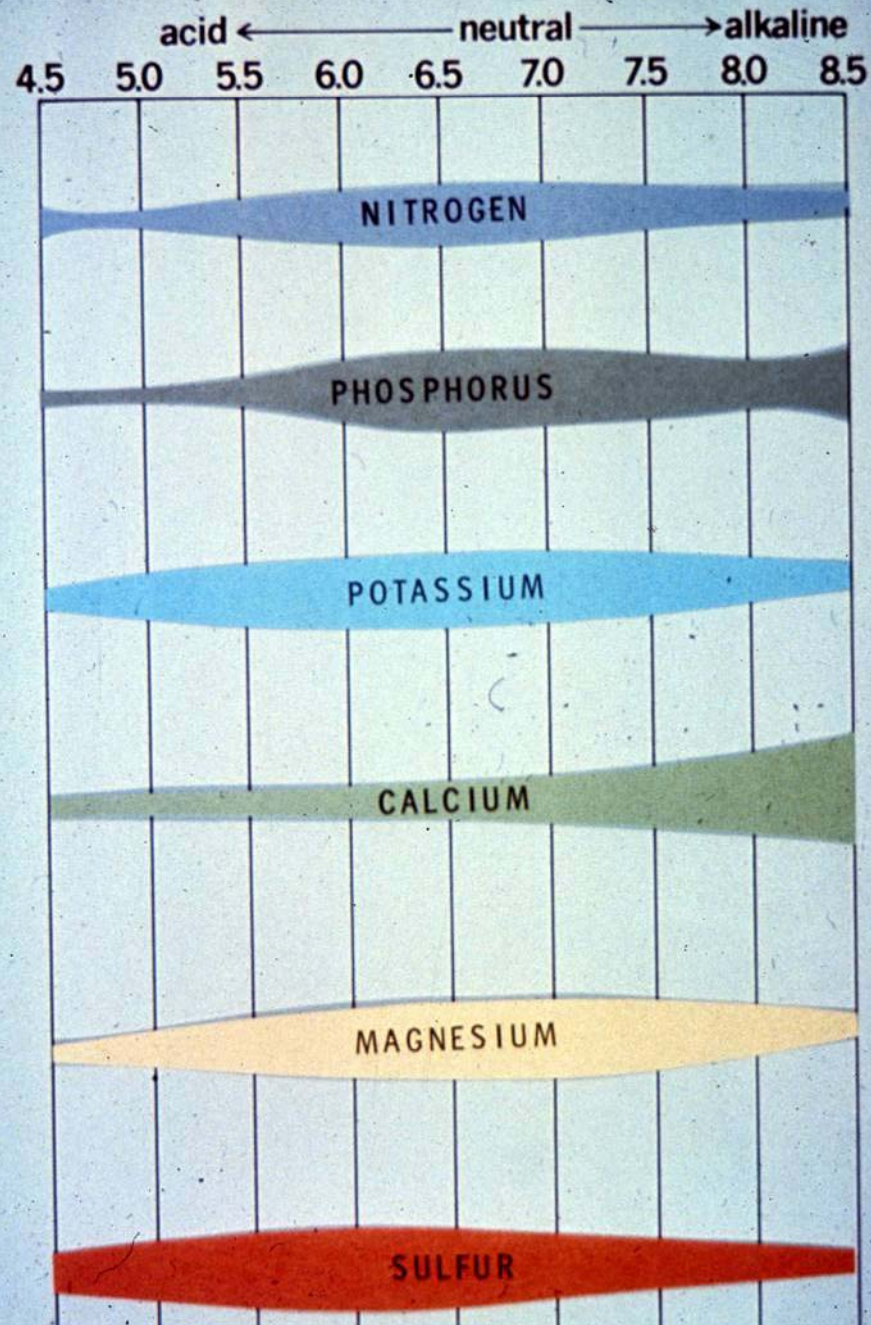
• <http://www.extension.umn.edu/distribution/horticulture/components/M1193fig02.html>

# Soil pH Effects on Soil Properties

- Availability of most essential and non-essential elements.
- Microbial activity.

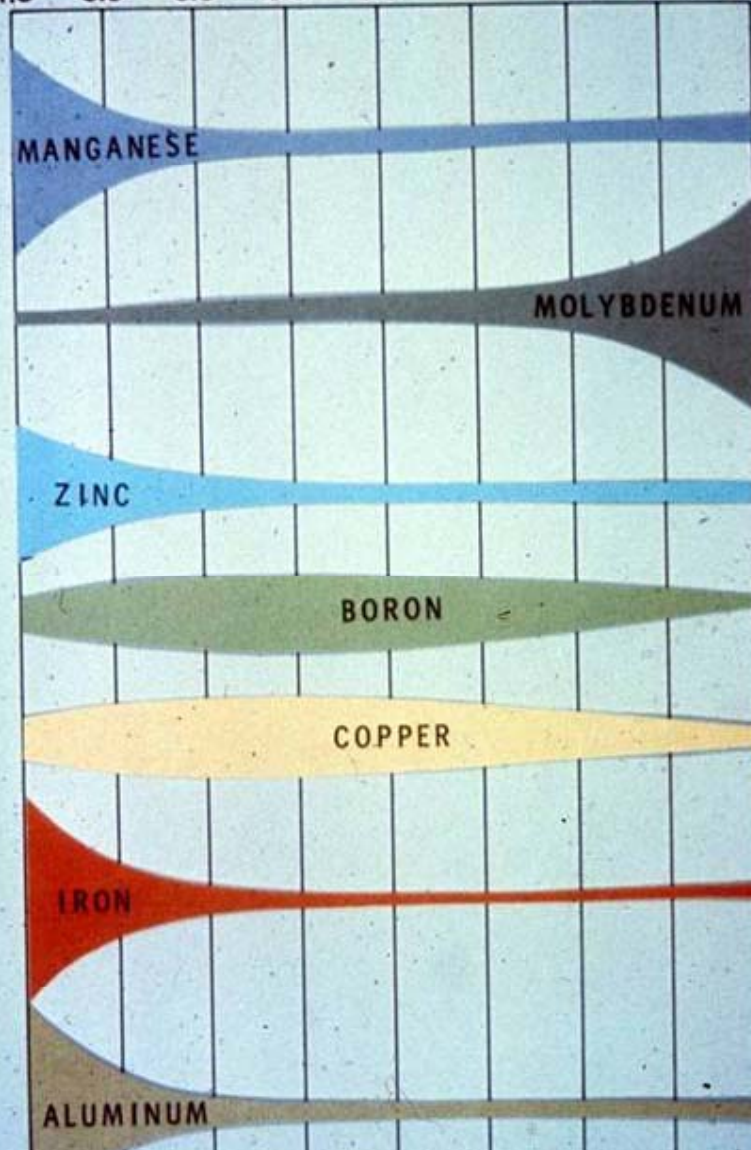


# Relationship of plant nutrient availability to soil pH



# Relationship of plant nutrient availability to soil pH

acid ← ————— neutral ————— → alkaline  
4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5







Lime

No lime



# Can the soil pH be raised ?

- Some crops may have higher optimum pH range
- Soil pH can be raised by addition of lime materials
  - Calcitic limestone
  - Dolomitic limestone



# Can the soil pH be lowered ?

- Some crops may have lower optimum pH range
- Soil pH can be lowered by addition of acid-forming fertilizers

Elemental Sulfur (S)



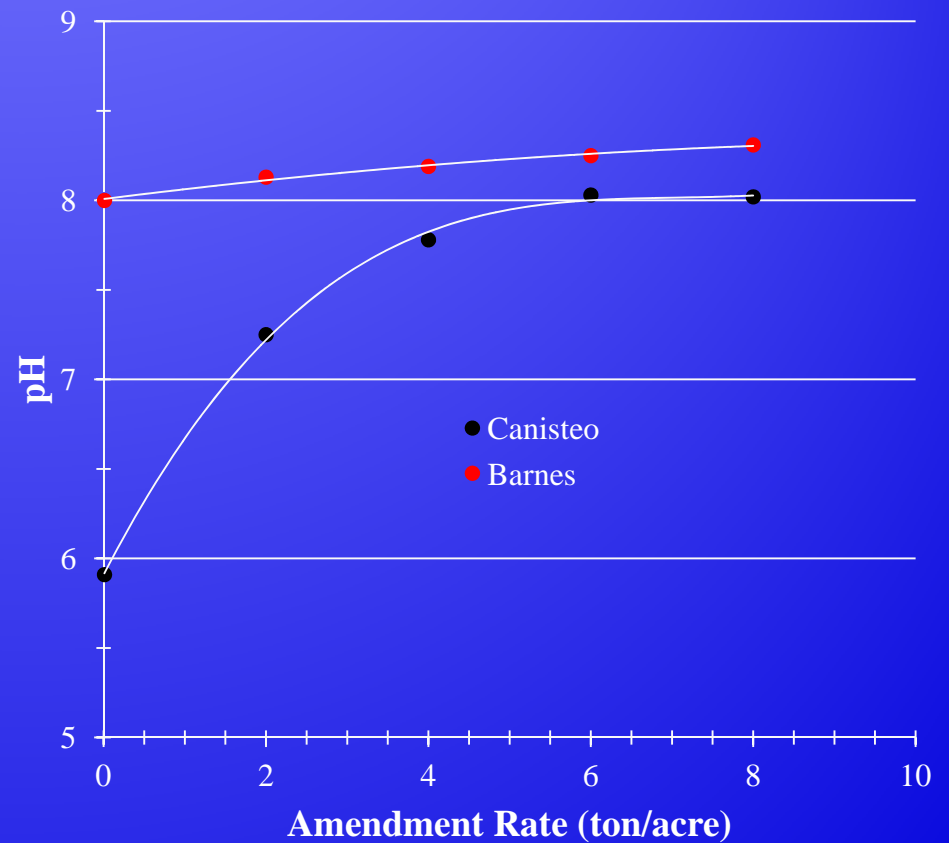
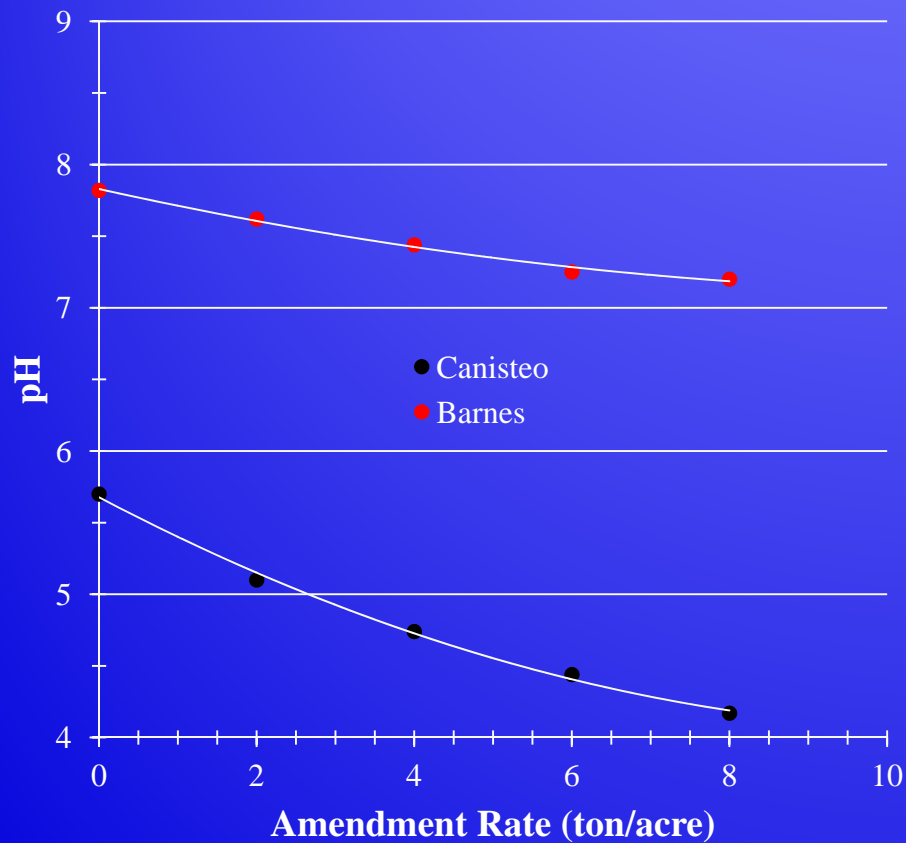
Aluminum Sulfate [ $\text{Al}_2(\text{SO}_4)_3$ ]



Ammonium Nitrate  $(\text{NH}_4)\text{NO}_3$



# Soil response to adjusting pH





# Handouts

- Class room protocols
- Calibration experiment